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Pinyon Seedling Distribution Among Soil Surface Microsites

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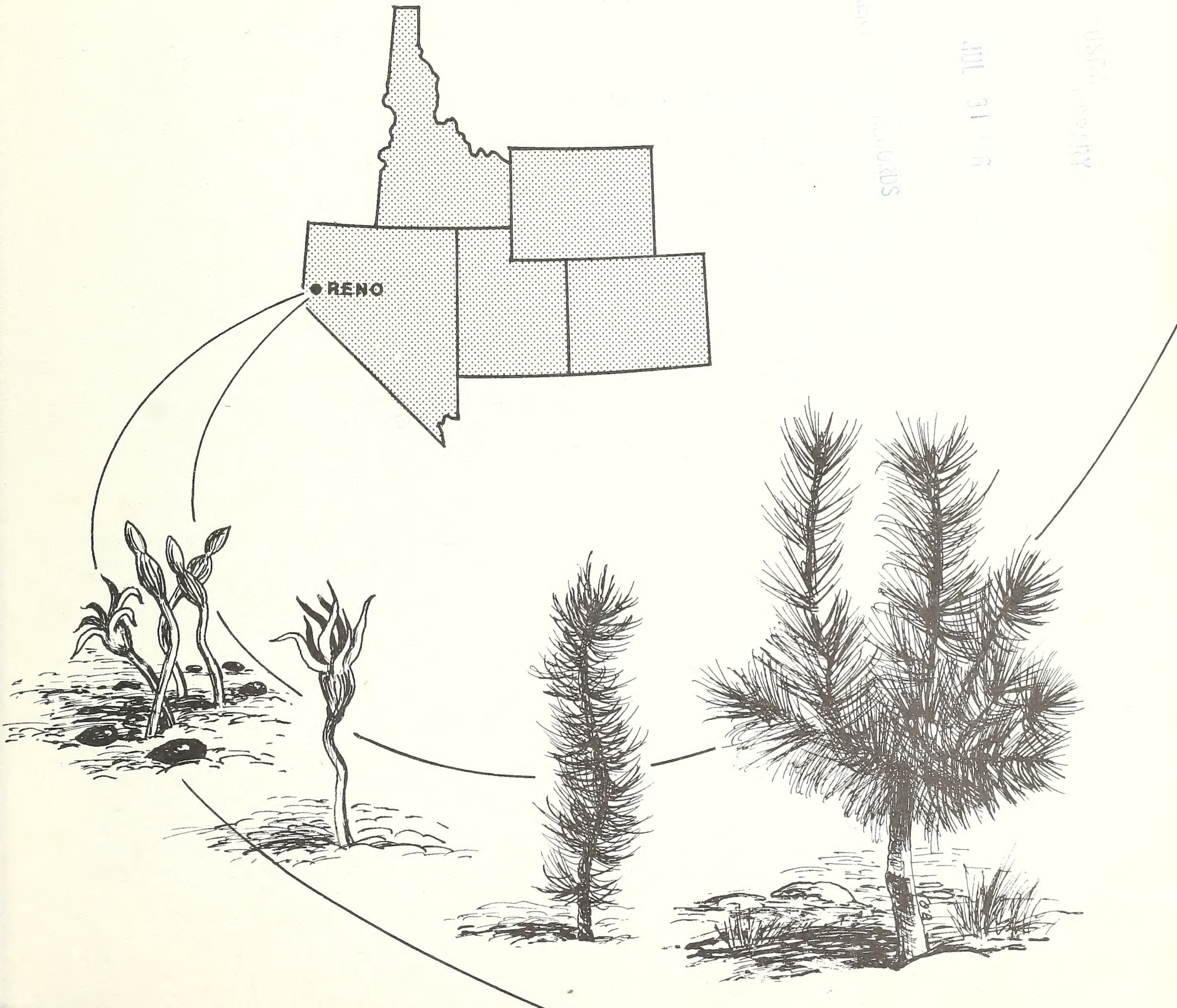

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RESEARCH SUMMARY

A highly variable number of pinyon seedlings ($\overline{X}$ = 5,480 seedlings/ha, CV = 126 percent) occurred in fully stocked singleleaf pinyon (*Pinus monophylla*)-Utah juniper (*Juniperus osteosperma*) stands. Pinyon seedlings were always more numerous (87 percent) on soil surface microsites adjacent to the tree than in the interspace between trees. Pinyon depends upon a standing crop of seedlings rather than soil seed reserves for species perpetuation. Seedling numbers rapidly decline following tree harvest. Seedlings in fully stocked stands may be of limited importance to species perpetuation because of tree longevity. But the concentration of seedlings in juxtaposition to the parent tree improves opportunities for management of natural regeneration by slash disposal or burn treatments.

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INTRODUCTION

Pinyon seedlings require a nurse plant for establishment. The nurse plant and seedling need not be the same species (Emmerson 1932), but in fully stocked stands this condition is highly probable. The enhancement of conifer seedling establishment in a microenvironment that ameliorates temperature and moisture extremes has been well documented (Youngberg 1965; Cochran 1973). In pygmy forests of the Southwest, seedlings of pinyon (*Pinus edulis*) and one-seed juniper (*Juniperus monosperma*) have been observed to occur in greater numbers under the tree crown for this reason (Meagher 1943; Johnsen 1962). Meagher did not measure seedling distribution patterns of pinyon, but he adequately demonstrated that shade and water increase rate of germination and survival of planted pinyon seed.

Little is known about singleleaf pinyon (*Pinus monophylla*) seedling numbers and their distribution within stands. Such information is important to land managers who must consider tree regeneration in balancing forage and wood product resources of these woodlands. An extensive preliminary study was, therefore, undertaken to provide baseline data for the number and distribution of singleleaf pinyon seedlings in fully stocked stands within the Great Basin.

METHODS

Square study plots, 20 m to a side, were established on 10 fully stocked stands in Nevada on various aspects at elevations of 2 030 m to 2 200 m. Fully stocked stands are defined by the Society of American Foresters (1958) as those stands where tree species effectively occupy all growing space. The soil surface within stands is heterogeneous and was classified into three general soil surface microsites—duff, transition, and interspace—based on percent needle cover and needle depth. Duff was defined as a soil surface microsite covered (at least 90 percent) by pinyon needles to a depth greater than 0.5 cm. Soil microsites having 20 to 90 percent of the soil surface covered by needles with an average depth less than 0.5 cm were defined as transition. Interspace soil microsites were characterized by less than 20 percent needle cover of less than 0.5-cm depth.

A series of five transects, 20 m in length, were laid out parallel to each other cross-slope at 5-m intervals across each study plot. Tree cover was determined by line intercept (Canfield 1941). Understory cover, number of pinyon seedlings (juveniles with a crown area less than 25 cm^2 and a height less than 30 cm), and the soil surface microsite were recorded within a 50- by 50-cm frame placed at every meter mark on the transects.

To determine seedling distribution from the tree bole, five pairs of trees were randomly selected for tree-to-tree transects in each study plot. Paired trees were greater than 20 cm in diameter (at stump height) and had at least 1 m of interspace between them. A series of 50- by 50-cm frames were laid down contiguously from tree bole to tree bole and understory cover, pinyon seedling numbers, and soil surface microsite recorded within each frame.

Numbers of seedlings found in parallel and tree-to-tree transects were totaled separately on each soil surface microsite for each study site. The percentage of the total seedlings within each soil microsite and the number of seedlings per square meter of soil surface microsite was determined for the 10 study sites and analyzed separately in one-way analysis of variance tests. An arcsine transformation was used on percentages to give a more normal distribution pattern to the data. Significant differences ($P = 0.05$) among means were determined using Hartley's sequential methods of testing (Snedecor 1956).

RESULTS AND DISCUSSION

Sampled stands were dominated by singleleaf pinyon with lesser amounts of Utah juniper (*Juniperus osteosperma*). Tree cover varied from 26 to 63 percent of the ground surface on the 10 study sites. Understory cover on all study sites was less than 8 percent. A total of 137 singleleaf pinyon seedlings were recorded in the parallel transects and 78 seedlings in the tree-to-tree transects. Mean seedling density across all sites was estimated at 0.5 seedlings/m^2 but varied from 0 to 2.28 among sites.

The estimated mean number of singleleaf pinyon seedlings per hectare was large ($\overline{X} = 5{,}480$) but highly variable (CV = 126 percent) among sampled stands. More pinyon seedlings occurred in the duff than in transition or interspace soil surface microsites on all sites. The duff microsite occupied the greatest portion of the soil surfaces, but the number of seedlings was disproportionately higher than would be expected by chance location (table 1). The majority (87 ± 18 percent) of seedlings occurred under or adjacent to the tree crown (table 1) as reported for *Juniperus monosperma* seedlings (84 percent) in Arizona woodlands (Johnsen 1962). The preponderance of seedlings near the parent plant suggests that safe sites for seedling establishment are sparse (Horn

1981). The number and location of safe sites control the size and the distribution of pinyon seedling populations.

Estimates showed that both parallel and tree-to-tree transects had greater seedling density in the duff surface microsite (table 1). Differences in seedling density estimates between transect types occurred and may be the result of sampling only larger trees in tree-to-tree transects. Nevertheless, the duff microsite appears more favorable for seedling establishment, a response opposite that observed for most understory species (Everett and Koniak 1982). Understory provided little or no cover ($\bar{X}$ = 2.6 percent ground cover; CV = 130 percent) on microsites containing seedlings.

Table 1.—Proportion of total pinyon seedlings (percent) and seedling density (m²) in the soil microsites and the proportion of sample area occupied by each soil microsite for all sites

	Soil microsite		
	Duff	Transition	Interspace
Parallel transects			
Percent of total			
Microsite	46.9[a1]	24.3[b]	28.8[b]
Seedlings	83.0[a]	4.1[b]	12.9[b]
Seedling density	.95[a]	.19[b]	.31[b]
Tree-to-tree transects			
Percent of total			
Microsite	50.2[a]	23.3[b]	26.0[b]
Seedlings	67.0[a]	17.0[b]	17.0[b]
Seedling density	.72	.41	.34

[1]Significant differences (P = 0.05) in rows denoted by superscripts.

Total number of seedlings (78) encountered in tree-to-tree transects is marginal for reliable estimates of pinyon seedling distribution from the tree bole, but seedling density definitely decreases with distance from the tree bole and especially at the duff edge (table 1 and fig. 1). The 150- to 200-cm distance class encompasses the average duff radii (167 cm) of the sample trees. Duff is shallow at the crown edge, increasing in depth under the crown, and often decreasing in depth immediately adjacent the tree bole. In duff, the germinating seed can establish root-mineral soil contact in a microenvironment less prone to desiccate the root tip as it emerges from the seed hull (our own observations; Lanner 1981).

Pinyon seedlings appear of limited importance for species perpetuation in fully stocked stands. On fire-safe sites, large trees rarely die and they monopolize site resources over a long life span, 350 years (Meeuwig 1979; Meeuwig and Cooper 1981). Most seedlings have only a short time in which to succeed or perish because of annual summer drought and sporadic drought years. When stands burn, fires consume both duff and seedlings. No pinyon seedlings were recorded on prescribed burns of pinyon-juniper woodlands for 5 years following fire (Everett and Ward 1984). Seedlings may represent the germinating surplus seed of an efficient dispersing system. The large, nutritious seeds of pinyon encourage their harvest and dispersal by both rodents and birds (Emmerson 1932; Vander Wall and Balda 1977; Ligon 1978; Lanner and Vander Wall 1980; Lanner 1981).

The concentration of pinyon seedlings under the crown provides management with an opportunity to enhance or discourage natural pinyon regeneration. If regeneration is to be curtailed, prescribed burning of stands or individual trees automatically eliminates a majority of the standing seedling crop. Exposing seedlings to the full sunlight reduces seedling survival significantly. Seedling survival on 10 tree harvest sites declined from a preharvest total of 100 to seven and then one in the first and third years following tree harvest. On four adjacent uncut sites, seedlings increased from eight to 20 the first and third years following tree harvest. After tree harvest, a moderate slash cover may be applied to increase seedling survival (Meeuwig and Bassett 1983).

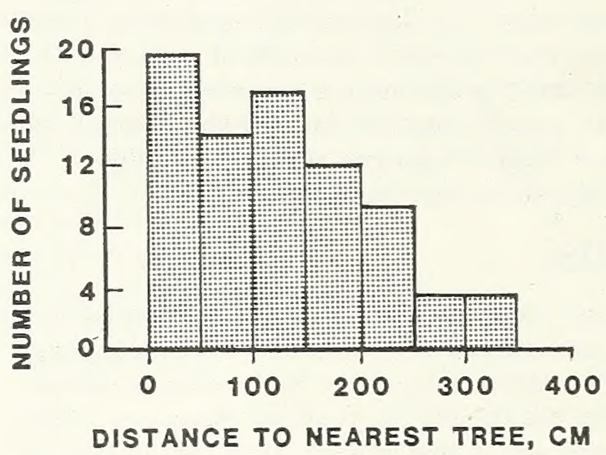

Figure 1.—Distribution of pinyon seedlings in distance classes from the nearest tree. (The 150- to 200-cm distance class encompasses the mean duff radii [$\bar{X}$ = 167 cm]).

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KEYWORDS: singleleaf pinyon, regeneration, stocking rate

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